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10/715,859	11/19/2003	Hiromi Sakima	245742US2	5595

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EXAMINER	
CARRILLO, BIBI SHARIDAN	

ART UNIT	PAPER NUMBER
1792	

NOTIFICATION DATE	DELIVERY MODE
03/12/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/715,859	SAKIMA, HIROMI	
	Examiner	Art Unit	
	Sharidan Carrillo	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 January 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11 and 13-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11 and 13-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: The disclosure is objected to because it is unclear how F/C refers to the "flourine/chlorine" ratio since there is no chlorine compound found in the C4F8 species. The examiner suggests that F/C refers " to "flourine/carbon" ratio.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-11 and 13-19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 6, 13, and 18 are indefinite because it is unclear how "F/C" ratio represents fluorine/chlorine since there is no chlorine present in the CF based gas. The examiner suggests amending the claims to recite "fluorine/carbon".

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 13-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Van Autryve et al (U.S. 6,014,979).

Re claim 13, Van Autryve teaches a method and apparatus for performing plasma processing, which comprises a chamber 25 for carrying out plasma processing of the substrate; a gas supply system (Fig. 1a) for supplying oxygen (deposit removing gas, as instantly claimed) and CF4 (dummy substrate etching gas, capable of plasma etching a dummy substrate); a dummy substrate made of silicon (col. 9, lines 17-18). The apparatus of Van Autryve is fully capable of performing the first plasma process and the second plasma process, as claimed. Additionally, col. 8, lines 20-25 teach that it is desirable to perform a cleaning process stage between multiple etching cycles. Therefore, Van Autryve teaches performing multiple etch cycles. Col. 4, lines 5-15 and col. 5, lines 40-60 teaches etching the substrate with a plasma comprising a halogen containing process gas prior to cleaning the chamber.

Van Autryve teaches performing multiple etching cycles in between the cleaning stage, wherein the etching cycle employs a plasma (col. 4, lines 5-15). Col. 9, lines 35-40 and col. 10, lines 35-37 teaches that in the cleaning stage, the cleaning gas composition *does not leave behind any other residue compositions* on the surfaces of the sacrificial collar in the chamber. Col. 8, lines 20-25 teach performing the cleaning stage between "multiple" etching cycles. Re claims 14-17, col. 9, lines 16-30 teaches the cleaning stage using a dummy silicon wafer and introducing a fluorinated gas (CF4)

in combination with oxygen. With regard to a ratio of flow rates of gases, applied during the chamber cleaning, as per claim 18 and with regard to a high frequency power, applied during the plasma processing, as per claim 19, it is noted that these limitations do not provide any additional structural element, but recite specific processing parameters established for particular processing and the apparatus of Van Autryve is fully capable of providing and maintaining such parameters. Furthermore, it is well settled that the manner of operating does not differentiate apparatus claim from the prior art if the prior art apparatus teaches all of the structural limitations of the claims, consult *Ex parte* Marsham, 2 USPQ 2-nd 1647 (BPAI 1987). It is also stated that the apparatus claims must be structurally distinguishable from the prior art in terms of structure, not function, consult In re Danley, 120 USPQ 528, 531 (CCPA 1959).

6. Claims 13-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Qian et al. (6136211).

Qian teaches a chamber in which a first and second plasma process are carried out (Fig. 3), wherein the second plasma process includes a plasma etching process, the second plasma etch process does not include deposits accumulated in the chamber since in one or more of the etching steps a cleaning gas (CF4) is added to the etchant gas (oxygen) to remove etching residue entirely from the etching process (col. 11, lines 20-25, col. 9, lines 15-20). Qian teaches a gas supply system to supply the cleaning and etching gas (Fig.2, elements 200, 70). The etching gas, i.e. would have the capability of etching a dummy substrate (i.e. wafer). Additionally, since the prior art of Qian teaches the same etching gas, it would be capable of etching any substrate (i.e.

dummy wafer). The claim language of "plasma-etching a dummy substrate during a dry cleaning process carried out by using the dummy substrate after the first plasma process and prior to the second plasma process", "stabilizing an etching rate of the second plasma process carried out right after the drying cleaning step" and "wherein a first and second CF based gas are used in the first and second plasma process, respectively, and a fluorine/chlorine (F/C ratio of the first CF-based gas is smaller than that of the second CF-based gas", are directed to process limitations which do not further structurally define the apparatus. Re claims 14-16, refer to col. 9, lines 10-18. Re claim 17, Qian teaches etching the substrate and cleaning the chamber simultaneously. The semiconductor substrate being etched reads on the limitations of claim 17. Re claim 18, the flow rate ratio is taught by the prior art of Qian. Col. 9, lines 25-30 teaches a volumetric flow ratio of the cleaning gas (i.e. CF4) to the etchant gas (oxygen) in the range of 1:20 which reads on 5%, which is within applicant's claimed range. Re claim 19, the limitations of 3.18W/cm2 to about 4.78W/cm2 is equivalent to 994-1494 Watts. Col. 7 of Qian teaches an RF voltage between 100 to about 5000 Watts, which falls within applicant's claimed range.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made

to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

9. Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Van Autryve et al (U.S. 6,014,979), in view of applicant's admission of the prior art and further in view of Yamada et al. (6159862).

Re claim 1, Van Autryve teaches a method and apparatus for performing plasma processing, which comprises a chamber 25 for carrying out plasma processing of the substrate; a gas supply system (Fig. 1a) for supplying oxygen (deposit removing gas, as instantly claimed) and CF4 (dummy substrate etching gas, capable of plasma etching a dummy substrate); a dummy substrate made of silicon (col. 9, lines 17-18). The apparatus of Van Autryve is fully capable of performing the first plasma process and the second plasma process, as claimed. Additionally, col. 8, lines 20-25 teach that it is desirable to perform a cleaning process stage between multiple etching cycles. Therefore, Van Autryve teaches performing multiple etch cycles. Col. 4, lines 5-15 and col. 5, lines 40-60 teaches etching the substrate with a plasma comprising a halogen containing process gas prior to cleaning the chamber.

Re claim 1, the limitations are met since Van Autryve teaches performing multiple etching cycles in between the cleaning stage, wherein the etching cycle employs a plasma (col. 4, lines 5-15). Col. 9, lines 35-40 and col. 10, lines 35-37 teaches that in the cleaning stage, the cleaning gas composition *does not leave behind any other residue compositions* on the surfaces of the sacrificial collar in the chamber. Col. 8, lines 20-25 teach performing the cleaning stage between "multiple" etching cycles. The limitations of the "second plasma processing step includes a plasma etching performed without producing deposits" are inherently met since the cleaning stage after the first plasma processing step removes all the residue and since Autryve teaches cleaning in between "multiple" etching cycles, thereby implicitly suggesting that the cleaning step does not have to be performed after each etching cycle since no deposits are present, but cleaning after multiple etching cycles. Additionally, the limitations of producing no deposits in the chamber would inherently be met since Autryve is performing the same method steps, using the same gases, as the instantly claimed invention. Re claim 1, the skilled artisan would reasonably expect the etching rate of the second plasma processing step to be stabilized since Van Autryve is performing the same method steps using the same gases as the instantly claimed invention.

Re claim 1, Van Autryve fails to teach the specific F/C ratio. However, applicant's admits in Fig. 12B and page 2, lines 8-20of the specification, that it is well known in the art that a depo process is followed by a depoless process for dry etching a silicon oxide Furthermore, the depo processs uses a CF gas with a smaller F/C ratio, which leaves a visible amount of polymers in comparison to the depoless process which

a larger F/C ratio which leaves no polymers attached to the chamber. This is further supported by Yamada et al. in col. 3, lines 20-35 which teaches that low F/C ratios are an indication of polymer deposition. Fig. 12B and page 2 of applicant's specification teaches that it is well known to adjust the fluorine/carbon ratio for successive etch steps, such that a first plasma etch has a F/C ratio which is smaller than the F/C ratio of a successive etch step. Therefore, both applicant's admission of the prior art and Yamada teaches that a low F/C ratio is an indication of polymer deposition in comparison to a high F/C ratio, wherein no polymers are present. Given the teachings of applicant's admission of the prior art and Yamada, one would reasonably expect the first etch of Van Autryve to have a low F/C ratio since polymers are present after the first etch. One would reasonably expect a successive etch step, after the dry cleaning step, to have a high F/C ratio since less polymers would be present as a result of removal of polymeric residue from a previous dry cleaning step. Re claims 2-5, 14-17, col. 9, lines 16-30 teaches the cleaning stage using a dummy silicon wafer and introducing a fluorinated gas (CF4) in combination with oxygen.

10. Claims 6-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Van Autryve et al (U.S. 6,014,979) in view of applicant's admission of the prior art and further in view of Yamada et al. (6159862), as described in paragraph 9 above, and further in view of Qian et al. (6136211).

Re claim 6, Van Autryve fails to teach the specific F/C ratio. However, applicant's admits in Fig. 12B and page 2, lines 8-20 that it is well known in the art that a depo process is followed by a depoless process for dry etching a silicon oxide

Furthermore, the depo processs uses a CF gas with a smaller F/C ratio, which leaves a visible amount of polymers in comparison to the depoless process which a larger F/C ratio which leaves no polymers attached to the chamber. This is further supported by Yamada et al. in col. 3, lines 20-35 which teaches that low F/C ratios are an indication of polymer deposition. Fig. 12B and page 2 of applicant's specification teaches that it is well known to adjust the fluorine/carbon ratio for successive etch steps, such that a first plasma etch has a F/C ratio which is smaller than the F/C ratio of a successive etch step. Therefore, both applicant's admission of the prior art and Yamada teaches that a low F/C ratio is an indication of polymer deposition in comparison to a high F/C ratio, wherein no polymers are present. Given the teachings of applicant's admission of the prior art and Yamada, one would reasonably expect the first etch of Van Autryve to have a low F/C ratio since polymers are present after the first etch. One would reasonably expect a successive etch step, after the dry cleaning step, to have a high F/C ratio since less polymers would be present as a result of removal of polymeric residue from a previous dry cleaning step.

Autryve et al., as modified by applicant's admission of the prior art and Yamada et al. do not teach the claimed flow rate ratio used during the dry cleaning step for removing deposits from the chamber. Autryve teaches the same gases of CF4 and oxygen.

Qian et al. teach a volumetric flow ratio of the flow rate ratio of the cleaning gas (i.e. CF4) to the etchant gas (oxygen) in the range of 1:20 which reads on 5%, which is within applicant's claimed range (col. 9, lines 25-30). The volumetric flow ratio is

sufficiently high to react with and remove substantially all the etch residue from the chamber upon completion of the etching process (abstract, col. 4, lines 50-55, col. 9, lines 25-35). It would have been obvious to the skilled artisan to have modified the flow rate of the CF4 and oxygen gases of Autryve, to include a volumetric flow ratio of 1:20, as taught by Qian et al., for purposes of effectively removing all the etch residue from the chamber. Re claim 7, the limitations of 3.18W/cm2 to about 4.78W/cm2 is equivalent to 994-1494 Watts. Both Autryve et al. (col. 9, lines 59-60) and Qian et al. (col. 7, lines 5-10) teach the power level of the RF frequency within applicant's claimed range. Additionally, Qian et al. also teach the same 13.56 MHz frequency as taught by applicant's specification. Re claims 8-11, refer to col. 9, lines 15-30 of Autryve.

11. Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable Chen et al. (6394104), in view of applicant's admission of the prior art and further in view of Yamada et al. (6159862).

Chen et al. teach a first plasma etch step (col. 2, lines 28-35) using CF4/CHF3 to planarize a spin on glass layer. After etching the wafers in the etch chamber, polymer builds up in the interior of the chamber (step 44). Step 46 teaches a dry plasma clean process using a dummy silicon wafer (col. 2, lines 60-65) using a deposit removing gas (oxygen) and a etching gas of CF4 (col. 2-3 bridging). Col. 3, lines 18-22 teaches dry plasma cleaning process removing polymer buildup form the interior of the chamber. Col. 3, lines 14-19, teaches processing "N" lots of production wafers after the plasma dry cleaning process. The limitations of a second processing step are met since the wafers are again processing by a spin on glass etchback using a plasma gas. The

limitations of no deposits in the chamber during the second plasma processing step would inherently be met since Chen et al. is performing the same method steps, using the same gases, as the instantly claimed invention.

Re claim 1, Chen fails to teach the specific F/C ratio. However, applicant's admits in Fig. 12B and page 2, lines 8-20 that it is well known in the art that a depo process is followed by a depoless process for dry etching a silicon oxide Furthermore, the depo processs uses a CF gas with a smaller F/C ratio, which leaves a visible amount of polymers in comparison to the depoless process which a larger F/C ratio which leaves no polymers attached to the chamber. This is further supported by Yamada et al. in col. 3, lines 20-35 which teaches that low F/C ratios are an indication of polymer deposition. Fig. 12B and page 2 of applicant's specification teaches that it is well known to adjust the fluorine/carbon ratio for successive etch steps, such that a first plasma etch has a F/C ratio which is smaller than the F/C ratio of a successive etch step. Therefore, both applicant's admission of the prior art and Yamada teaches that a low F/C ratio is an indication of polymer deposition in comparison to a high F/C ratio, wherein no polymers are present. Given the teachings of applicant's admission of the prior art and Yamada, one would reasonably expect the first etch of Chen to have a low F/C ratio since polymers are present after the first etch. One would reasonably expect a successive etch step, after the dry cleaning step, to have a high F/C ratio since less polymers would be present as a result of removal of polymeric residue from a previous dry cleaning step. Re claims 2-4, refer to col. 3, lines 1-4. Re claim 5, refer to claim 12 of Chen et al.

Response to Arguments

12. The objection to the specification is maintained for the reasons recited above.

13. The rejection of claims 13-19 as being anticipated by Van Autryve is maintained for the reasons recited above.

14. Re claims 1-5, the examiner agrees with applicant's arguments that Van Autryve or Chen fail to teach the claimed limitations of the F/C ratio. However, claims 1-5 are now rejected as being unpatentable over Van Autryve or Chen in view of applicant's admission of the prior art and Yamada et al., for the reasons recited above. Specifically, applicant's admits on page 2 of the instant specification, that it is well known in the art that a depo process is followed by a depoless process for dry etching a silicon oxide. Furthermore, the depo processs uses a CF gas with a smaller F/C ratio, which leaves a visible amount of polymers in comparison to the depoless process having a larger F/C ratio which leaves no polymers attached to the chamber. This is further supported by Yamada et al. in col. 3, lines 20-35 which teaches that low F/C ratios are an indication of polymer deposition. Fig. 12B and page 2 of applicant's specification teaches that it is well known to adjust the fluorine/carbon ratio for successive etch steps, such that a first plasma etch has a F/C ratio which is smaller than the F/C ratio of a successive etch step. Therefore, both applicant's admission of the prior art and Yamada teaches that a low F/C ratio is an indication of polymer deposition in comparison to a high F/C ratio, wherein no polymers are present. Given the teachings of applicant's admission of the prior art and Yamada, one would reasonably expect the first etch of Chen or Van Autryve to have a low F/C ratio since

polymers are present after the first etch. One would reasonably expect a successive etch step, after the dry cleaning step, to have a high F/C ratio since less polymers would be present as a result of removal of polymeric residue from a previous dry cleaning step.

15. Applicant further argues that the claims are not patentable over Van Autryve or Chen since both references use the same gas for the first and second processing step. While it is true that both prior art uses the same gas, applicant's arguments are unpersuasive because they are not commensurate in scope with the instantly claimed invention. The claims do not require different gases for each of the plasma etching steps.

16. Applicant further argues that Van Autryve and Chen fail to teach stabilizing an etching rate of the second plasma step. Applicant's arguments are unpersuasive since the skilled artisan would reasonably expect the etching rate of the second plasma processing step to be stabilized since Van Autryve and Chen are performing the same method steps using the same composition as the instantly claimed invention.

17. Re claim 6, Applicant argues that Qian fails to teach a claimed flow ratio. Specifically, applicant argues that Qian teaches a ratio of 2000%. The examiner disagrees. The ratio of 1:20, as taught by Qian, is equivalent to 5%.

18. Applicant argues that Van Autryve and Qian fail to teach performing three different plasma processes in the same chamber. Applicant argues that the apparatus of Qian and Van Autryve are configured to carry out only two different steps in the same chamber. Applicant's arguments are unpersuasive since both claims 13 and 18 require

a first and second plasma process. The claims do not require a third plasma process. In the event that applicant considers the dry cleaning process as a third plasma process, the limitations would be met by the prior art since Van Autryve and Qian teaches cleaning between multiple etch cycles.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sharidan Carrillo whose telephone number is 571-272-1297. The examiner can normally be reached on M-W 6:30-4:00pm, alternating Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Barr can be reached on 571-272-1414. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Sharidan Carrillo/
Primary Examiner, Art Unit 1792

bsc